Sandwich Panels
Supporting Growth with an Established and Proven Technology

Kristof Dedecker, Huntsman Polyurethanes,
Everslaan 45, B-3078 Everberg, BELGIUM

Joris Deschaght, Huntsman Polyurethanes,
Everslaan 45, B-3078 Everberg, BELGIUM

Ravindra Kumar, Huntsman Polyurethanes
A-10/A, FDDI Complex, Sector-24, Noida, INDIA

ABSTRACT

Sandwich panels in India have been showing strong growth mainly in telecom shelters, cold chain and industrial buildings. Huntsman is a leading supplier of polyurethane (PU) chemicals to sandwich panel manufacturers across the world. In this paper, we would like to share our experience gained in Europe for sandwich panel applications.

In the Europe, Africa, Middle East (EAME) region, the market for polyurethane-cored sandwich panels has been growing rapidly over the last years and is currently estimated to be 130 mio m2 per annum. The majority of these panels are produced on laminators while the discontinuous press technique is mainly used for more specialized panel designs. The emerging economies in Europe (Russia, Eastern Europe, Balkans) are currently facing huge sandwich panel growth with many new laminators being put in place. Growth figures are shown for various regions in Europe and the main drivers are discussed.

The main advantages of PU-cored sandwich panels, such as lightweight construction, superb thermal insulation and a rapid and economic construction technique, are definitely appealing for an emerging economy like India. The application of PU-cored sandwich panels versus other construction techniques is compared. After this, an evaluation of the advantages of PU versus other insulating materials is also presented.

This paper further describes the various foaming technologies, as they are currently practiced in Europe, and their relevance for the Indian market. An important distinguishing element is of course the foam blowing agent. While Europe mainly uses pentane, India still has an option to use HCFC 141b. The two blowing agent options are compared technically in terms of foam processing as well as in terms of the properties of the resulting panel.

Another important choice is between polyisocyanurate (PIR) and the more classical polyurethane (PUR) technology. This choice is mainly determined by local fire codes and the availability of laminators able to process PIR. Again, the actual situation in Europe regarding PIR/PUR preference is discussed for the various regions, together with the main drivers and future outlook.

In summary, this paper describes the main technical choices to be made for the sandwich panel market in India, based on a long-term European experience by Huntsman.

THE EAME MARKET FOR SANDWICH PANELS

The market of PU-cored sandwich panels has been showing a steady growth over the last decade. It is estimated to be 405 kt PU in 2006 (EAME region = Europe, Africa and Middle East), which is equivalent to ± 130 mio m2 of panels. The majority of these panels are produced via continuous lamination (320 kt PU in 2006 – EAME) while the discontinuous press technique had an estimated consumption of 85 kt PU in 2006. In figure 1, the growth of the continuous lamination market since 1995 is given.

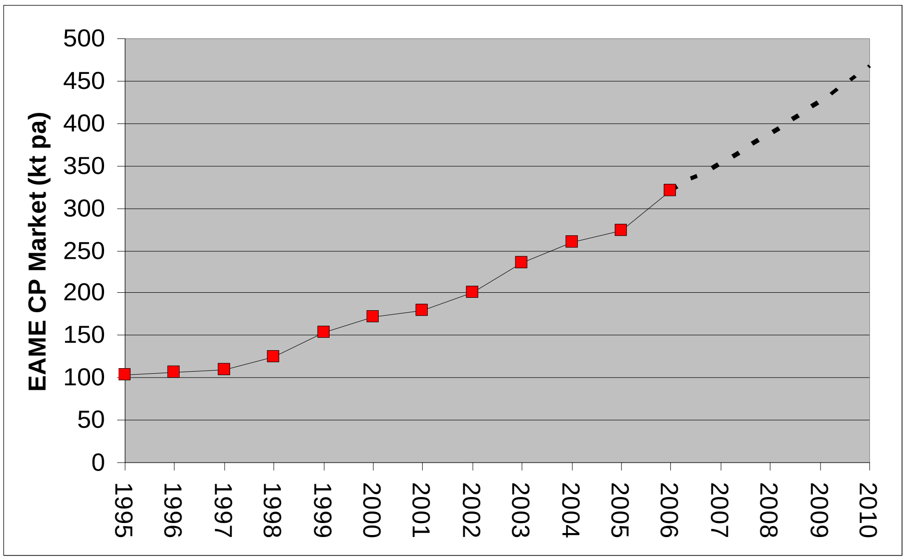

Figure 1 : PU volume in kilotonnes per annum used in continuous lamination of sandwich panels in EAME.

It can be seen from the above graph that the continuous sandwich panel lamination market has tripled over a period of only 10 years. The growth in sandwich panels prepared via the discontinuous press technique has been much more modest. This is mainly due to the fact that a discontinuous press can not reach the same production speeds as obtained with continuous lamination. Another element which has contributed to the growth of continuous lamination is the possibility to produce PIR foam with enhanced fire properties compared to PUR foam. The discontinuous press technique is less suitable to process PIR technology. In the coming years, it is expected that continuous lamination will continue to grow faster than the discontinuous press technique. However, a number of elements also favor the discontinuous press technique. Firstly, it requires a smaller capital investment, allowing an easy exploration of geographical areas where sandwich panels are not yet established. Secondly, it can be more suitable for specialized panel designs or for small orders.

After having looked at the size of the sandwich panel market and the two production techniques, we now turn to where sandwich panels are mainly produced in EAME and where the highest growth can be expected in the coming years. In figure 2a, the total PU consumption of 320 kt in sandwich panels (lamination) is split up per region.

In figure 2b, the number of new laminators in the years 2007 and 2008 is given for all regions.

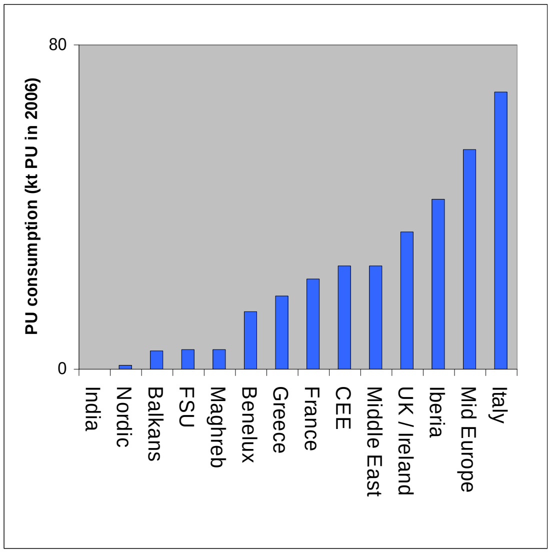

Figure 2 a
PU consumption per region in 2006. Sandwich panel lamination. EAME + India

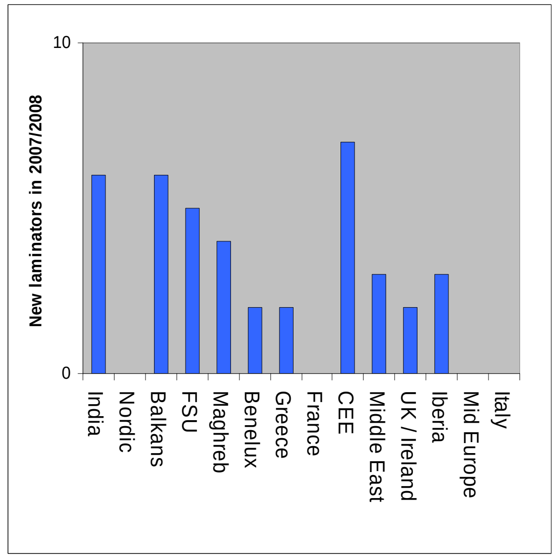

Figure 2b
New laminators in EAME+India in 07-08.

Through comparison of both figures, it can be seen that many new laminators are currently being put in emerging markets (India, former Soviet Union (FSU), Balkans, Maghreb) where the 2006 consumption was still modest. A huge growth of sandwich panel production can be expected in those regions in the coming years. At the other hand, regions where sandwich panels are already well established (Benelux, Greece, Central Eastern Europe, Middle East, UK, Iberia) are still attracting new laminator investments, clearly a sign of healthy end-market demand. Next, the drivers for growth of sandwich panels are examined in more detail.

DRIVERS FOR GROWTH

The main application area of sandwich panels are industrial and commercial buildings (roof cladding/wall cladding/partition walls) which account for about 80% of all produced sandwich panels. Another important application is the cold store industry (refrigerated warehouses and cold store units) which accounts for about 15 % of the total market.

One of the main drivers which has supported composite panel growth is the fast and economic construction technique. The low density of PUR foam allows a light supporting structure and large projects can be realized in a short timeframe allowing further money saving. Further, the costs per m2 are modest compared to other construction techniques.

Additionally to the above, the superb insulation performance of rigid polyurethane foam keeps the energy cost low, an argument which has gained even more importance after the recent sharp increase in energy costs. Finally, the element of design freedom is not to be underestimated. Sandwich panels allow a wide range of profiles and colors and buildings with a high class, modern look are typically obtained.

Looking at the success of PU-cored sandwich panels, it is also interesting to compare with sandwich panels containing other insulating cores. Overall, it is estimated that 70% of all sandwich panels in EAME contain PUR/PIR cores. The remaining part of the sandwich panel market is shared between mineral wool and (to a smaller extent) expanded polystyrene (EPS) as insulating core.

Mineral wool-cored panels are mainly chosen in those applications/countries where high requirements for reaction or resistance to fire are in place. However, also PIR-cored panels obtain good ratings in fire tests and allow to access certain applications which are demanding in terms of fire approvals. Mineral wool panels have however a number of disadvantages. First of all, the higher thermal conductivity requires the use of much thicker panels (or alternatively a higher energy bill). Secondly, the lack of a vapor barrier makes mineral wool unsuitable for cold store applications. Furthermore, mineral wool is not self-adhesive to steel and an extra glueing step is required. Finally, the higher density will require a heavier supporting structure.

EPS-cored panels are not self-adhesive to steel (glue required) and have a higher thermal conductivity than PU foam in combination with poor fire properties. They are basically only chosen in those cases where price prevails on any quality requirement.

FIRE REQUIREMENTS

As discussed above, PIR foam offers excellent fire properties. The EAME market for PU-cored sandwich panel lamination in 2006 was roughly split 85/15 between PUR/PIR. Before exploring the regional differences in fire requirements, let us first be clear on the similarities and differences between PUR and PIR.

The overall lamination process for PUR and PIR is identical : the same laminator set-up can be used for producing PUR and PIR foam. Foam densities and thermal conductivities are fairly similar for PUR and PIR (PIR can be slightly lower in thermal conductivity because of the lower water content). Finally, both are in principle self-adhesive to steel although certain suppliers offer glue systems for high index PIR to ensure sufficient adhesion and long-term properties.

One of the main differences between PUR and PIR is the processing of the rising foam. While PUR foam is typically cured in a conveyor at 35-40ºC, PIR foams require higher conveyor temperatures (60ºC for high index PIR) to ensure a good conversion of NCO groups into the isocyanurate ring structure and obtain sufficient adhesion to the steel. Another difference is the content of polymeric isocyanate in the overall formulation which can be as high as 70 wt% for PIR, while this number is typically more around 60% for PUR. Overall PIR technology has a narrower processing window compared to PUR. An unsuitable conveyor temperature or too intense foam rolling will more easily lead to undesired panel properties when using PIR foam.

The current fire requirements in Europe can be seen in figure 3.

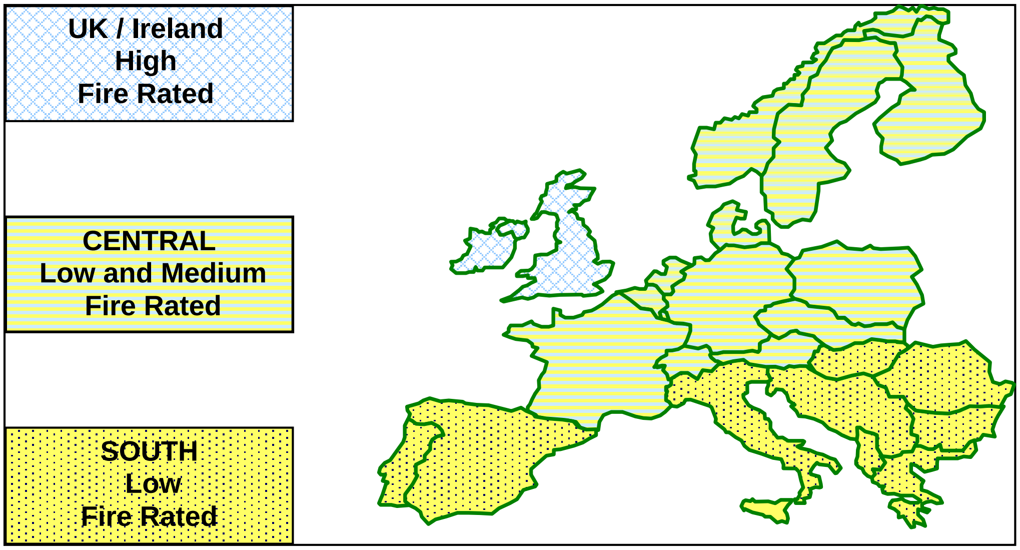

Figure 3 : Simplified picture of fire requirements in Europe for sandwich panels.

As indicated in figure 3, the highest fire requirements for sandwich panels are in place in the UK and Ireland. Insurance companies have developed large scale tests which can only be met with PIR foams.

In the central area, both low fire-rated foam and medium fire-rated foam can be used, depending on the exact application and country. Various fire tests are in place which have up to now been national (Epiradiateur M1 test in France, Brandschacht B1 test in Germany, etc…). These tests can generally be met with PUR foam containing flame retardants and hence, PIR penetration in the central part is still limited.

Finally, in the southern part of Europe, fire requirements have been low up to now and low fire-rated PUR foams can be used. Despite this, certain panel producers have voluntarily offered panels containing PIR foam in an attempt to diversify from competition.

The scenario described in figure 3 will definitely be subject to changes in the coming years. Firstly, the European sandwich panel product norm (EN14509) was recently voted through successfully. It contains a harmonized fire test across Europe, called SBI (Single Burning Item). This test will replace existing national tests. Secondly, insurance companies can further push their standards in Continental Europe. Thirdly, there is an increasing demand for fire resistance where again PIR foam is needed. Overall, the penetration of PIR panels is expected to increase gradually.

BLOWING AGENT CHOICE

In continuous lamination, the blowing agent choice in EAME is relatively straightforward. It is given in figure 4.

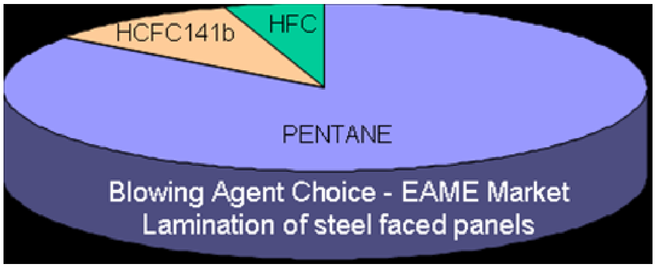

Figure 4 : Blowing agent choice in EAME market for sandwich panels.

As can be seen, the majority of the market uses pentane (mostly n-pentane). It has a limited solubility in polyol blends but foam technology has been established to cope with this. Explosion-proof equipment is a must when using pentane. HCFC141b is still used outside EU (FSU, Maghreb, Middle East, India) but phase-out schedules are also expected here. HCFC141b has a good solubility in polyol blends and is easily processable. Finally HFCs are used in certain cases because the resulting foam will have better fire properties. They are also used on some older European lines which were not made explosion proof. The main factor limiting their use in sandwich panels is the high price of HFCs.

In sandwich panels prepared in a discontinuous press, the blowing agent choice is more fragmented. HFCs are much more popular because quite some old presses cannot handle pentane. Also water blown foams have a part of the discontinuous panel market.

INDIAN SANDWICH PANEL MARKET

As mentioned higher, the discontinuous press technique is suitable for exploring new markets with a relatively small capital investment. This is exactly what has happened in India over the last 5 years. The volume of PU used in discontinuous panels has been growing fast up to a level of 8000 tonnes in 2007. This can be seen in figure 5.

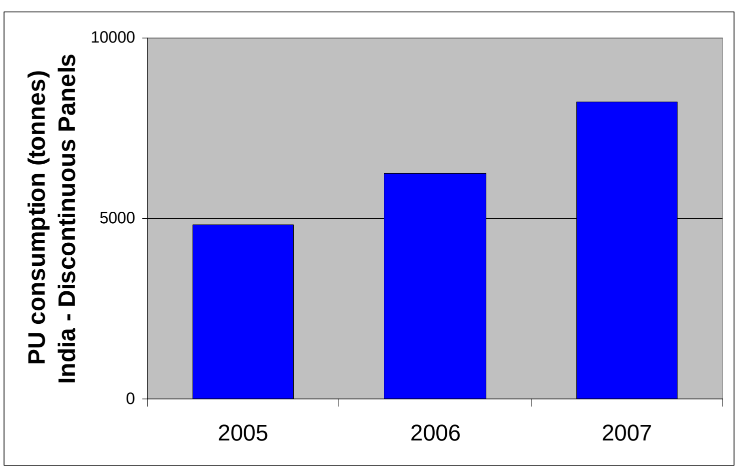

Figure 5 : PU consumption in sandwich panels prepared via discontinuous press technique in India.

The popularity of sandwich panels prepared discontinuously has triggered the installation of the first continuous laminator for sandwich panels at the end of 2006. In the period 2007-2008, several new laminators are being put in place to serve the increased demand for sandwich panels. An overview of all planned (and completed) laminator investments is given in figure 6. The main applications for sandwich panels in India are currently telecommunication shelters, cold chain and industrial buildings.

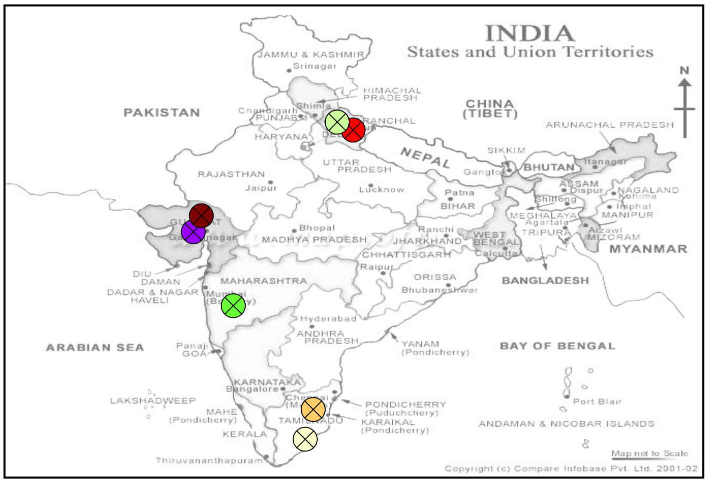

Figure 6 : Laminators for sandwich panels installed in India in 2007-2008

FUTURE OUTLOOK FOR SANDWICH PANELS

For EAME, it is expected that the high growth in continuous lamination of sandwich panels will continue for the foreseeable future. The amount of new laminator investments is impressive and reflects the need for sandwich panels in the building industry. PU will clearly benefit from a more stringent energy legislation and high energy prices in general. Furthermore, the European sandwich panel market should also become more transparent once the product norm (EN 14509) is published and CE labeling is possible. In terms of technology, PIR foam is expected to gradually penetrate the market in order to meet the more stringent fire requirements. Pentane is expected to remain the blowing agent of choice.

For India, a high growth is expected in both continuous lamination and discontinuous press technique for sandwich panels. In today’s market, PU consumption is still higher for discontinuous press compared to continuous lamination but it is expected that in the medium term, PU consumption will be higher in continuous lamination. In terms of technology, the requirement for PIR foam has to be further evaluated in view of fire code developments and involvement of insurance companies. In the medium term, HCFC141b will remain the blowing agent of choice, in the longer term, the most likely choice is pentane.

HUNTSMAN POLYURETHANES IN INDIA

Huntsman Polyurethanes India is headquartered in Navi Mumbai with a sales office in Noida, NCR. The Polyurethanes Systems House at Navi Mumbai has a state-of-the-art polyol blending plant that ensures speedy and customised solutions to customers. Having faith in the potential of the Indian market, Huntsman Polyurethanes made investments in local assets many years ago and has consistently delivered value to ensure enduring customer relationships.

Huntsman Polyurethanes is a global leader in providing MDI-based polyurethane solutions for the insulation needs of the construction industry. In India, we have been offering solutions for composite panels in various applications that include telecom shelters, cold chains and building insulation.

Our rigids technical centre in Navi Mumbai is well equipped with a polyurethanes dispensing machine and foam testing equipment. Our local technical team provides on-site technical support to our customers. It is well supported by our Technical Development Centers in Europe and Asia-Pacific to ensure efficient transfer of technology and delivery of technical projects as agreed with our customers.

SPEAKER BIOGRAPHY

Kristof Dedecker

Kristof Dedecker joined Huntsman Polyurethanes in 1998 after receiving his Ph.D. degree in Polymer Chemistry from the University of Leuven - Belgium (KUL). He has been working on various R&D issues related to rigid foam. He is currently Marketing and Technology Manager EAME for Sandwich Panels and Pre-insulated Pipes and is based at Everberg in Belgium.